1. A *Grammoptera*, a single specimen, doubtful if not an extreme variety of *G. amentata*.

2. A small species of the group *Monohamminæ*, one imperfect example.

3. A species apparently allied to *Cylindilla*.

4. An imperfect specimen of a species possibly of the group *Niphoninæ*.

The following is indeterminable:—

POGONOCHERUS GRANULATUS, *Motsch. Bull. Mosc.* 1866, i. p. 174.

From the description it cannot belong to the genus *Pogonocherus*.

DESCRIPTION OF THE PLATES.

PLATE I.

Fig. 1. Xenophyrama purpureum.
2. Corennys sericata.
3. Psephactus remiger ♂.
4. Eustrangalis distenioïdes ♀.
5. Lemula decipiens.
6. Toxotinus longicornis.
7. Encyclops olivaceus.
8. Pyrrhona læticolor.
9. Phlyctidola metallica.
10. Dolophrades terrenus.
11. Paraclytus excultus.
12. Aglaophis colobotheoïdes.

PLATE II.

Fig. 1. Callapœcus guttatus.
2. Xenicotela fuscula.
3. Mesosella simiola.
4. Nanohammus rufescens.
5. Apalimna liturata.
6. Terinæa atrofusca.
7. Xylariopsis mimica.
8. Praolia citrinipes.
9. Clytosemia pulchra.
10. Eryssamena spinidorsis.
11. Miccolamia cleroïdes.
12. Mecynippus pubicornis.

On the Influence of Wave-currents on the Fauna inhabiting Shallow Seas. By ARTHUR R. HUNT, M.A., F.G.S. (Communicated by Dr. J. GWYN JEFFREYS, F.R.S., F.L.S.)

[Read 5th June, 1884.]

THE action of waves below the surface of the water decreases so rapidly as the depth increases that naturalists have been in the habit of neglecting submarine wave-action altogether. In proof of this I may refer to Sir Charles Lyell's assertion that "the agitation caused by waves, even during storms, extends to a very slight depth" ('Elements of Geology,' 6th ed. p. 20); and to Dr. Günther's statement that "the agitation of the water caused by the disturbances of the air does not extend beyond the depth of a few fathoms," and that "below this surface-stratum there is no other movement except the quiet flow of ocean-currents" ('Introduction to the Study of Fishes,' p. 298).

In a paper published in the 'Transactions of the Devonshire Association' in 1883 I described a glass bottle trawled in 40 fathoms in the English Channel, and endeavoured to prove, from its condition and contents, that it had been subjected to alternate periods of wave-disturbance and of repose ("The Submarine Geology of the English Channel off the Coast of South Devon," Part III., Trans. Dev. Assoc. vol. xv. pp. 359–365). Professor G. G. Stokes, Sec. R.S., has been so good as to peruse the paper referred to, and to favour me with a letter on the subject of wave-disturbance on the sea-bottom, from which the following is an extract. Referring to waves with a period of 17 seconds (such as he had himself had an opportunity of observing), and acting at a depth of 40 fathoms, Professor Stokes writes:—

"Lensfield Cottage, Cambridge,
18 Jan., 1884.

" . . . I find for the velocity of propagation of the waves 87·14 feet per second in the deep, and 73·05 in the shoal, or 59·41 miles per hour in the deep, and 49·13 in the shoal. Also, for the ratio of the velocity at the bottom to the velocity at the surface 0·5332 to 1. As to the actual velocity at the surface, that will depend on the height we assign to the waves. Taking it as eight feet above or below mean level in the shoal, 16 feet from crest to trough in all, I find a velocity of 1·989 miles per hour at the surface, and 1·036, say 1 mile, an hour at the bottom. The height may, however, well be greater than what I have assumed, and the velocity will be greater in proportion.

"But even a velocity of only 1 mile per hour might make a material difference if combined with a tidal current. Thus, suppose we had a tidal current running 2 miles an hour, approximately in the same direction as the waves are travelling in, or in the contrary direction. Then, whereas with the tide alone we should have a steady current of 2 miles, and with the waves alone a reciprocating flow of 1 mile, with the two together we should have a flow rapidly changing between 1 mile and 3 miles. Now, taking the resistance to vary as the square of the velocity, the 3-mile current would have two and a quarter times as much power to roll over a shell or bottle as the tidal current alone; and, moreover, this current would be rapidly shifting, so that a bottle would be continually moving about if the water were able to move it at all. I think therefore that, even with a depth as great as 40 fathoms, the effect of the waves is not to be disregarded, at least in the case of a locality subject to oceanic swells, and where there is a sensible tidal current as well. It is likely enough that it is only in the case of a specially heavy ground swell that the effect of the waves would be liable to be significant. . . . I need hardly say that if the depth be less than what I have supposed, the proportion of wave-velocity to that at the surface for a given period of wave will be greater than the eight fifteenths I have calculated for the case chosen, and that same proportion of eight fifteenths would be attained for waves of a smaller period than 17 seconds."

As Professor Stokes has referred to wave-currents of 1 mile per hour as being possible at a depth of 40 fathoms, it may be as well to state what effect such currents would be capable of producing, without taking into account the increase in power due to their reciprocal character.

According to Minard, quoted by Mr. T. Stevenson ('On Harbours,' p. 238), a current of 0·6819 mile per hour will sweep along fine gravel, and a current of 1·3638 mile an hour will roll along rounded pebbles 1 inch in diameter. Thus the 1-mile current is more than sufficient to roll along fine gravel.

There is thus no lack of evidence that the power of wave-currents at a depth of 40 fathoms is occasionally considerable; that it is by no means exhausted at that depth; and that, for the occasional disturbance of a sandy bottom, the depth of 50 fathoms may be attained, or even exceeded.

The extreme limit of depth affected by wave-currents is of minor importance in the present inquiry; it will suffice if it be conceded that appreciable wave-disturbance is occasionally experienced on the sea-bottom at the depth of 50 fathoms.

The occasional existence of such alternating currents being granted—and of their presence between tide-marks and in shallow water any observer can have ocular demonstration—we proceed to inquire whether the fauna inhabiting shallow and exposed seas is to an appreciable extent influenced by them. From the limited observations I have been able to make, I am disposed to think that the marine fauna referred to is influenced by such wave-currents to an extent that it is scarcely possible to overrate.

The marine fauna exposed to the action of waves may be conveniently divided into two groups of animals, viz. those that live on the tidal strand, and those that live in, or on, the sea-bottom outside tide-marks.

(1) *Animals Living on the Tidal Strand.*

These may be further considered under the following heads, viz.:—

(*a*) Animals living on rock or other firm foundation; and
(*b*) Animals living in sand or other incoherent deposit.

(*a*) *Animals living on a Firm Foundation.*—The methods by which animals living on, or in, rocks resist the attacks of waves are so well known that they need not occupy our attention. Suffice it to say that among them are included great powers of permanent attachment, as evidenced by the oyster and mussel; of temporary attachment, as evidenced by the limpet and sea-anemone; and of boring, as evidenced by the pholas and other rock-boring mollusks.

(*b*) *Animals living in Sand.*—The habitat being unstable under the attacks of waves and currents, no powers of attachment will serve the inhabitant. Safety lies in the celerity with which the animal can penetrate the sand, either to avoid being washed away in the denudation of the deposit, or to force its way to the surface through any accumulation that may be piled over it. We have a good example in the case of *Solen vagina*, one of the most active of mollusks in penetrating the sand in which it lives. Describing the genus, Dr. Gwyn Jeffreys observes:—" When the Solen is disturbed it . . . . . rapidly disappears below the surface to a depth of two or three feet" (Brit. Conch. vol. iii. p. 13).

(2) *Animals living at the Sea-bottom outside Tide-marks.*

The case of a rocky bottom needs no consideration, as the protection afforded is as great as on the tidal strand, whereas the wave-currents are weaker. There remains to consider the case of

(*c*) Animals that live in a sandy or muddy bottom, or have the power of burrowing into it; and (*d*) that of animals which live on the surface of the bottom.

(*c*) *Animals that live in a sandy or muddy bottom outside* *tide-marks* find their safety in their power of maintaining themselves to a greater or less extent below the surface of such bottom. This position of safety is attained in two ways, viz. either by the power of the animal to burrow rapidly in the deposit in which it lives, or by its power of retaining a safe position when once secured. Mr. Osler, referring to the burrowing of bivalves, has observed that "animals which from their small size or the little depth at which they reside are particularly liable to be exposed, will generally burrow readily; but the large species will scarcely attempt to bury themselves, except in the very young state" (Phil. Trans. 1826, p. 348). Irrespective of age, activity in burrowing varies greatly in different instances. This can be well seen in the case of the young of different species of *Cardium*, and in that of full-grown specimens of *Psammobia tellinella*. The compressed valves and hatchet-like form of the latter are clearly suited for rapid penetration, whereas the comparatively globular form of the Cardium is as evidently ill adapted to force its way through a resisting medium. As a matter of fact, when in captivity the cockles burrow very sluggishly, if at all, whereas the Psammobias do so most readily. In their natural homes the latter seek to escape by evading the wave-currents, the former to a great extent by passive resistance. *Psammobia tellinella* abounds in a deposit consisting of comminuted shells and small stones which occurs in the vicinity of Hope's Nose, the northern horn of Torbay, the materials being accumulated by strong currents. Through this deposit the *Psammobia* forces its way with great ease. If it were otherwise it is difficult to see how it could survive, as the character of the accumulation is sufficient proof of the amount of disturbance to which it is occasionally exposed.

The large cockle, *Cardium aculeatum*, is abundant in fine muddy sand off Paignton in Torbay. In this deposit the long spines of this species are of service to increase its holding-powers. An allied species, *C. tuberculatum*, whose shell is rough and ribbed but not spined, dwells in hard sand at and below low-water mark off the same place. The two species are not commonly found living together, though I have found specimens of *C. aculeatum* that had been washed in from sea, and their spines denuded in the process, living side by side in the hard ground with *C. tuberculatum*. In both these species the rough shells tend to prevent the mollusks being readily dislodged by the waves. Each species keeps to the ground best suited to it. The spines of *C. aculeatum* would apparently be too great an impediment in burrowing in the hard sand, whereas the spineless shell of *C. tuberculatum* would afford insufficient hold in the soft sand. A very slight advantage from form or sculpture might be of great importance in saving the cockles from local extinction; for in the case of Torbay the struggle for existence is so severe that both species are occasionally washed on shore in sufficient quantities to be carted away for manure.

Among the Veneridæ the following may be cited as provided with special mooring-apparatus, viz. *Venus casina* and *V. verrucosa*, with deep concentric ribs; and *Cytherea dione*, with concentric ribs and long spines in addition.

The two bivalves, *Psammobia tellinella* and *Cardium aculeatum*, are fair examples of active and passive resistance to the inroads of wave-currents by animals living close to the surface of the deposit which forms their habitat. Passive resistance in the case of the spinous cockles is facilitated by their ribs and spines, while it is supplemented by the powerful foot, which moors the animal to the sand and enables it to burrow in it, though at a comparatively low speed. Certain mollusks with smooth cells and sluggish habits, such as *Mya truncata* for instance, avoid the wave-currents by living at a safer distance below the surface of the bottom, being enabled to do this by means of the long tubes with which they are furnished. There can be no doubt that the long tubes possessed by many species of burrowing mollusks are valuable auxiliaries in self-defence, more especially in the case of the young, who, from their small size, would be affected by much slighter wave-currents than the adults, and would be in constant danger if obliged to live at the surface, or close to the surface, of the deposit that gave them shelter.

(*d*) *Animals that live on the Sea-bottom on Sand or Mud.*—This group of animals is more interesting, and at the same time more satisfactory to deal with, than either of those hitherto referred to. The special adaptations of structure to resist or evade wave-action exhibit great variety, while at the same time the animals themselves often offer the great advantage to the investigator of lending themselves to the test of experiment.

The following will serve for a few examples:—The Gastropod *Aporrhais pes-pelecani* is a sluggish mollusk that frequents exposed areas of sand a few fathoms below the surface of the water. Its long wing-like processes, jutting out on one side of the shell, though affording the animal a broad base on which to rest, appear at first sight to be a source of danger in case it were overturned. They are in reality self-acting pieces of mechanism that will, in the majority of instances, ensure the mollusk being ultimately left in its normal posture should it encounter wave-currents sufficiently strong to upset it. On examining a specimen of *Aporrhais pes-pelecani* it will be seen that, when on its back, it lies indifferently on either side of a line drawn between two points, of which the end of the middle wing-like process is one, and one of the nodules on the body-whorl the other. The shell will rock freely backwards and forwards across this line; and experiment proves that a very moderate alternate current will suffice to replace the shell in its normal position. I have tried this experiment over and over again, not only with *Aporrhais*, but also with heavy foreign shells furnished with spines, processes, and more or less developed lips, such as *Murex*, *Pteroceras*, and *Strombus*. In many cases the righting-action of wave-currents is most marked.

With *Aporrhais*, on the same exposed areas, are often found the Gastropods *Natica catena*, *Buccinum undatum*, *Nassa reticulata*, *Bulla hydatis*, and *Philine aperta*. All these are manifestly unsuited to withstand wave-currents on the surface of the bottom; but there is no occasion for making the attempt, as all burrow freely, travelling through the sand beneath the surface.

Asterias aurantiaca and *Antedon rosaceus* are good examples of two Echinoderms that successfully encounter wave-currents by methods totally diverse. The *Asterias* lies on the sand with an extended and rigid base, where its flattened form is eminently calculated to offer slight resistance to wave-currents. But as though this were insufficient for its safety, it has the power of sinking vertically in the sand, and of thus securing itself from all danger. *Antedon rosaceus* (the feather-star) is found frequenting the clear water off rocky headlands, where it is necessarily exposed to strong currents, both tidal and wave-engendered. Here nothing will avail but sheer strength in holding on; and this the feather-star possesses in an eminent degree, from the time it is first attached to weed or zoophyte in its early stages of growth, to the time when, a full-grown adult, it is free to exercise its limited powers of locomotion. I may here refer to Mr. Osler's description of the *Spatangus* sinking vertically into the sand by the action of its short, flat bristles (Phil. Trans. 1826, p. 347).

Among the Crabs there are at least three methods adopted for resisting wave-currents.

The rock-crabs (*Cancer*) fix themselves firmly in crevices, where they can bid defiance to the strongest waves. The swimming-crabs (*Portunus*) shovel away the sand with their flat swimming-feet, and speedily gain protection under the surface; whilst the hermit-crabs (*Pagurus*), inhabiting empty shells, secure a fair hold on the bottom by the length of their legs, the latter being long in proportion to the size of the bodies of the crabs and their strange coverings.

Moreover, the swimming-crabs are quite alive to the advantages, as well as the disadvantages, of reciprocal currents. I have seen one of these crabs make a rapid passage seawards by swimming with the outward-flowing wave-current, and settling down between the sand-ripples on the bottom when the shoreward current commenced to flow.

Mr. Couch, referring to the habit of the masked crab (*Corystes cassivelaunus*) burrowing in the sand, and "leaving the extremities of its antennæ alone projecting above the surface," suggested that the antennæ might assist in the process of excavation. Having kept one of these crabs in confinement for some little time, I venture to doubt the accuracy of this explanation, seeing that they descend into the sand backwards with the greatest agility, and thus leave the antennæ no opportunity of assisting in the operation. I incline to think that the function of the antennæ is to maintain a communication between the buried crab and the water above, as without some such connexion there would be a risk of the animals being occasionally buried to a dangerous depth by the accumulation of sand above them *. Mr. W. Thompson's statement that the antennæ in very small specimens "are much longer in proportion to the carapace than in the adult" (T. Bell, 'British Stalk-eyed Crustacea,' pp. 161, 162) harmonizes well with this hypothesis, as to ensure safety the young would have to burrow to a greater depth compared with the adults than would be proportionate to their size.

* *Note.*—When writing the above, I was unaware that so long ago as 1865 Mr. P. H. Gosse, F.R.S., had criticised Mr. Couch's theory as to the antennæ of *Corystes*, and had expressed his own opinion that their use was "to keep a passage open through the sand from the bottom of the burrow to the superincumbent water" ('Year at the Shore,' pp. 127–131). I much regret the unintentional plagiarism. —A. R. H.

The special contrivances by which shallow-water fishes elude wave-currents are similar to those that obtain in the cases of the mollusks, echinoderms, and crustaceans already referred to, although, as the fishes are more active, they have not to depend so much on a passive resistance. The fish elude the waves either by attaching themselves to fixed objects, by hiding under stones, by burrowing in the bottom, or by lying quiet whilst the alternate wave-currents cover them with sand.

The burrowing-habits of the sand-launce, *Ammodytes lancea*, are well known. Frequenting, as these fish do, shallow water, and even burrowing in tidal strands where the waves have the greatest power, they could scarcely successfully encounter the broken water in the shallows if exposed to its violence, and unable to take refuge in the sand.

Another well-known and remarkable fish is the two-spotted sucker (*Lepidogaster bimaculatus*), which has the power of attaching itself firmly to fixed objects by means of its ventral fins. The special defence of this species against wave-currents is perfect, so long as it can find some immovable object to which to attach itself *.

Perhaps of all marine fishes the most interesting in their connexion with wave-action are the flat-fishes. They seem to have changed their original forms and habits for the purpose of being able to live in shallow waters agitated by waves ; for it is well known that at first they swim vertically in the orthodox fashion.

All who have dredged for shrimps near the shore well know how abundant are the little soles, plaice, and dabs, from the size of a shilling upwards, that live on the same ground as do the shrimps, and have to conform to the same outward circumstances. If any of these little fish be placed in a vessel of sea-water with

* *Note.*—A specimen dredged in the gaping valves of a Pecten on July 5, 1884, stuck to its refuge whilst being dragged along the sea-bottom, hauled to the surface, and discharged with a dredgeful of dead shells on the boat's deck. This fish, when turned out of its shell in a small aquarium, would, on the water being rocked, manifest great anxiety to get back again. During a residence of more than a month in captivity it varied greatly in colour, from a decided red to a shade so pale as to make it an inconspicuous object when attached to the white interior of a Pecten-valve. Another specimen, dredged with algæ on rocky ground on July 20, was of an olive-brown colour. These fish are good examples of the protection against wave-currents afforded by form, and of the protection against animate foes afforded by colour.—A. R. H.

sand sufficient to cover the bottom, it will be seen how indifferent they are to oscillating currents, and how easily they evade them. They meet the danger either by flashing with great velocity under the sand, or by passive resistance, lying quite still whilst the sand-ripples formed by the rocking of the water cover them up. It has been thought that flat-fish cover themselves with sand for the purpose of concealment; but this hypothesis fails to meet the fact that among them are included many varieties, such as the halibut and skate, that grow to a large size, and can scarcely need to hide themselves from living foes. Moreover, such concealment cannot be assured to the feeblest of them, as the smallest and weakest have to move about after their own prey. Further, as the peculiar habit of swimming on the side, and the peculiar position of the eyes on the same side of the head, are not congenital, but acquired after the young are hatched, the latter when most exposed to be devoured by fish have not the benefit of the hypothetical means of protection from these enemies. On the other hand, when we see that these peculiar forms and habits afford a perfect protection against wave-currents, it seems reasonable to conclude that the said forms and habits have a very close connexion with the special dangers against which they are manifestly such efficient safeguards*.

Many of the visitors to the Southport Aquarium during the visit of the British Association in 1883 watched with interest the struggles of the king crabs (*Limulus*) to regain their normal position, when, by climbing the walls of their tank, they had fallen on their backs. It seemed anomalous that a crustacean should be so constituted as to be helpless in any position in its native element. Owing to the hemispherical form of the carapace of these crustaceans, no such difficulty would be experienced on an open coast in shallow water, as gentle wave-currents would suffice to restore them to position if by any chance upset.

* *Note.*—The following statement of Professor Moseley seems exactly in point:—". . . the young flat fish termed Platessæ . . . are often taken in the open ocean; and it appears probable that when there placed under unnatural circumstances, their development becomes arrested, and many probably perish eventually . . . . without the arrangement of their eyes ever becoming unsymmetrical. The deep sea is devoid of flat fish" . . . . (Nature, vol. xxvi. p. 563). It seems clear from the above that the horizontal position, unsymmetrical eyes, and quasi-burrowing habits of flat fish are peculiarities connected with their shallow-water habitats, and with them alone.—A. R. H.

In the foregoing pages I have called attention to the facts that wave-currents affect the bottom in shallow water, and that they are a source of danger to the fauna inhabiting such water; and I have adduced a few examples from my own limited experience of animals that are specially adapted to withstand the attacks of such wave-currents. It remains for me, in conclusion, to show how, under the influence of wave-currents, the variation of species may be promoted, and their local extinction brought about. The common spinous cockle, *Cardium echinatum*, will serve to illustrate the manner in which wave-currents may influence variation.

This species varies much in form and in length of spines. Mr. Gwyn Jeffreys describes two distinct varieties in addition to the type. The sand in which *C. echinatum* lives is also variable; it varies in size and character of grain, in specific gravity, and in the amount of its admixture with mud. Some localities are exposed to wave-currents, some to tidal currents, and some to both combined. Wave-currents acting alone, and giving rise to no general forward movement, sort and arrange the materials composing the bottom. Wave-currents in conjunction with tidal currents tend to produce a general motion of the bottom-deposit, if movable at all, causing denudation at one place and accumulation at another. A shell may withstand the local rearrangement of deposit caused by wave-currents, by passive resistance, moored in its locally disturbed bed; but against the more widely-spread motion caused by wave and tide combined more active resistance is necessary.

Cardium echinatum owes its safety to its powers of burrowing and to its spines, which, curved in the direction of its tubes, offer the least resistance to the cockle's penetration of the sand, and the greatest resistance to its dislodgment therefrom. When pitted against wave-currents the spines are of use to their owner, but when pitted against wave and tide together they must be prejudicial, as, notwithstanding their curvature, they cannot fail to offer great resistance to the animal in burrowing. Similarly, a shell of globular form will serve the purpose of a mollusk that relies on its powers of maintaining a fixed position, whereas a shell of a more compressed form will be better suited to one that depends for safety on its power of penetration. When the fry of such a variable species as *C. echinatum* is spread in countless millions over an area affected by wave-currents, it is reasonable to suppose that the varieties best suited to the bottom and locality will survive. The same may be said in the case of the fry being spread over an area affected by wave- and tidal currents combined. In this way different varieties will be localized in different places.

As an example of the difference in relative compression of different specimens of *C. echinatum*, I may instance two individuals from the English Channel and one from Torbay. The thickness in each case was 1·75 inch, and the length of the Channel specimens 2·175 and 2·4 inches respectively, and that of the Torbay specimen 2·1 inches. These examples were selected (out of a small number of specimens) owing to their uniform thickness making them convenient for comparison. There is no reason to suppose they are extreme cases of variation. The difference in penetrative power in these specimens due to difference in form would be considerable.

The genus *Cardium* may again serve to illustrate the influence of wave-currents on the local extinction of species.

In Torbay the most abundant cockles are *C. aculeatum* and *C. tuberculatum*, the former having very long spines, the latter having them quite rudimentary. These two species do not apparently thrive together (when their shells are perfect) in the same deposit in Torbay, though their habitats are not far apart, the one being soft and muddy sand, the other pure and firm sand. There can be little doubt that a radical change in the character of the two deposits in which these species respectively live would cause their local extinction, by making it impossible for them to offer a successful resistance to their enemies, the wave-currents. Whilst the two species referred to are locally abundant in Torbay, *Cardium echinatum*, the species most abundant, as a rule, on the British coasts, and whose spines are of an intermediate length, is much less common; for though often abundant in the earlier stages of growth, even undersized specimens are rare compared with *C. aculeatum* and *C. tuberculatum*. Neither the very soft nor the very hard sand seems to suit it.

In past ages, as evidenced by the raised beach on the islet known as the Thatcher, the dominant cockles of the locality were neither *C. aculeatum* nor *C. tuberculatum*, but *C. echinatum* and *C. edule*. There is plenty of geological evidence that in those days the sandstone cliffs were far more extensive than now, and the supply of sand, in consequence, more abundant; and we seem to have a case in point of the prevalence of particular species of shells being influenced by wave-currents acting on sea-bottoms that do not remain constant in constitution and character.

Preliminary Account of the Development of the Lesser Weever-Fish, *Trachinus vipera*. By George Brook, F.L.S.

(Read 1st May, 1884.)

[Plates III.–VI.]

The observations on which my paper is based have been made on eggs laid in my aquarium by fish which I have had in the tanks over two years. The conditions under which the development was carried on will not therefore be normal, and the direct rays of the sun were never allowed to fall on the eggs, as would be the case in nature.

The eggs of *Trachinus vipera* are laid in the summer. I have had them as early as April, both last year and this, as floating eggs. Dead eggs have been found at the bottom of the tanks in March. The eggs found in April were very few, and often not fertilized. It was not till the 6th of June that they began to show in any numbers, and with but a small proportion of unfertilized ones. They continued to be laid at intervals of three or four days during June and July; but the batches laid during the last few days of July were again few in number, and with a large proportion of unfertilized ova amongst them; and no ova were found in August at all.

The egg of *Trachinus vipera* is about 1·32 millim. in diameter, of a beautiful pearly white, and quite translucent, and contains from 20 to 30 small oil-globules which cause it to float on the surface of the water. These oil-globules are scattered over the upper hemisphere of the yolk, and lie between it and the vitelline membrane. They vary in size from ·12 to ·03 millim. The oil-globules cause the egg to float with the germinal disk downwards, so that the embryo is developed on its back, so to speak, and it is not until some time after hatching that the young fish is enabled to swim with the ventral surface downwards.

Eggs freshly extruded from the ovary are not spherical, as the egg-membranes are larger than the yolk, and appear wrinkled until the "breathing-cavity" gets filled with water, and it is